Gun-Only Magnet used f[redacted] Multi-Stage Depressed Colle (MSDC) Klystron

Description:

The goal of our effort is to develop a permanent magnet (PM) focused MSDC klystron. The limitation encountered when adapting MSDC technology to conventional permanent magnet focused klystrons is electron beam refocusing in the collector due to magnetic field reversals (see figures 1 and 2). To overcome this limitation imposed on klystrons that utilize PM focusing systems with conventional collectors, the internal volume of the collector is minimized. Minimizing the collector volume has the effect of limiting the maximum beam power that can be handled safely, and hence limits the maximum output power of the device.

The MSDC requires a much larger internal volume than its non-depressed counterpart and is more sensitive to stray magnetic fields within the collector region (see figures 3 and 4). Conventional PM focusing systems will not work for high efficiency MSDC klystrons exactly for this reason. The key in making an MSDC PM focused klystron is using a circuit which has no field reversals in the collector region. The Gun-Only magnet is the key to successful PM MSDC klystron technology and it is the idea of using the Gun-Only magnet approach for this application that is novel.

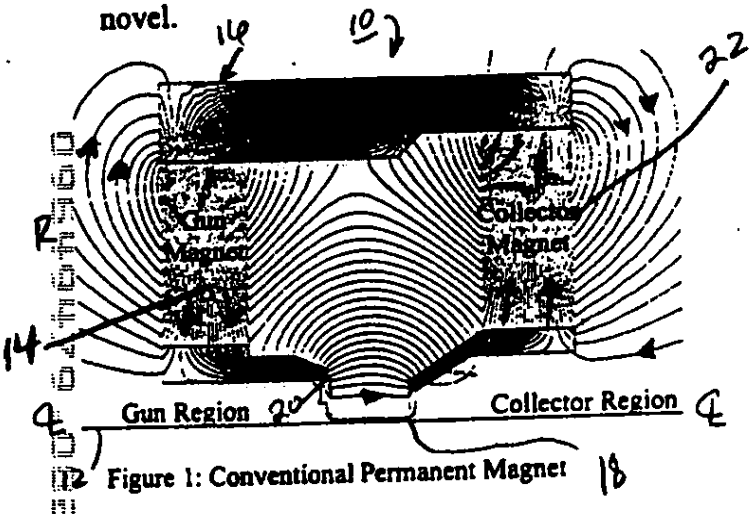

Figure 1: Conventional Permanent Magnet

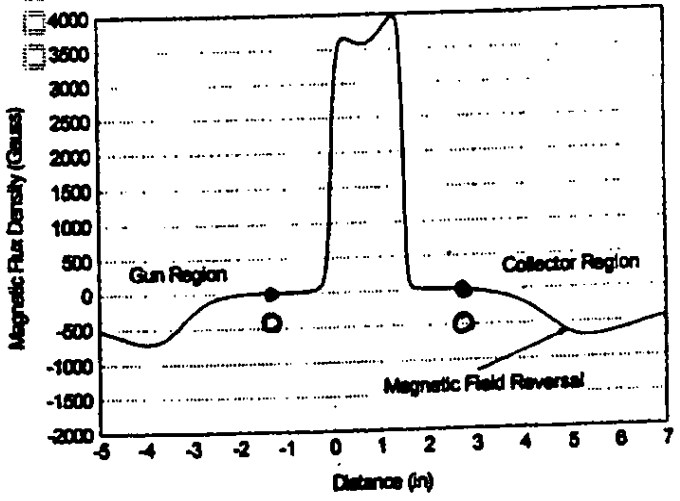

Figure 2: Conventional Permanent Magnet On-Axis Magnetic Flux Density. Notice the magnetic field reversal in the collector region.

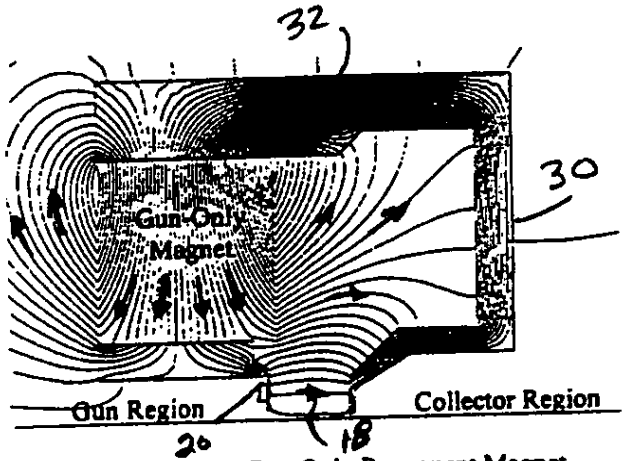

Figure 3: Gun-Only Permanent Magnet

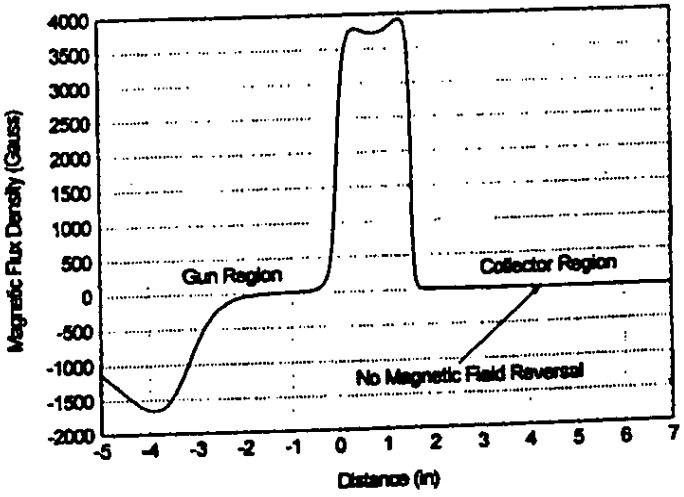

Figure 4: Gun-Only Permanent Magnet on-axis magnetic flux density. This PM circuit has no field reversal in the collector.

Gun-Only Magnet used for a [redacted]ulti-Stage Depressed Collecto[redacted]SDC) Klystron, Cont.

Description, Cont.:

The refocusing experienced by electrons as they enter the collector region in the presence of a magnetic field reversal can be seen in figure 5. Notice that many of the particles move radially outward, and are turned back towards the axis by the magnetic field. A simulation for the same collector, but with the Gun-Only magnet, can be seen in figure 6. Note the monotonic increase in radius of the particles as they impinge the collector. Simulation of a three (3) stage MSDC using the Gun-Only approach can be seen in figure 7.

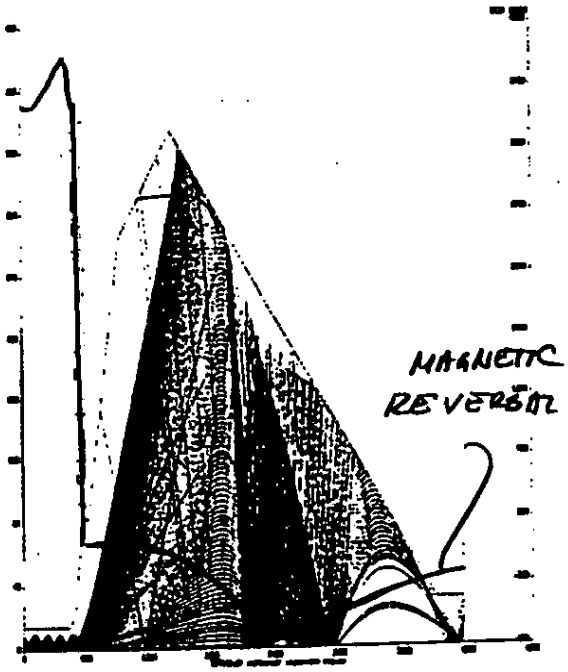

Figure 5: Simulation of electrons entering the collector region in the presence of a magnetic field reversal.

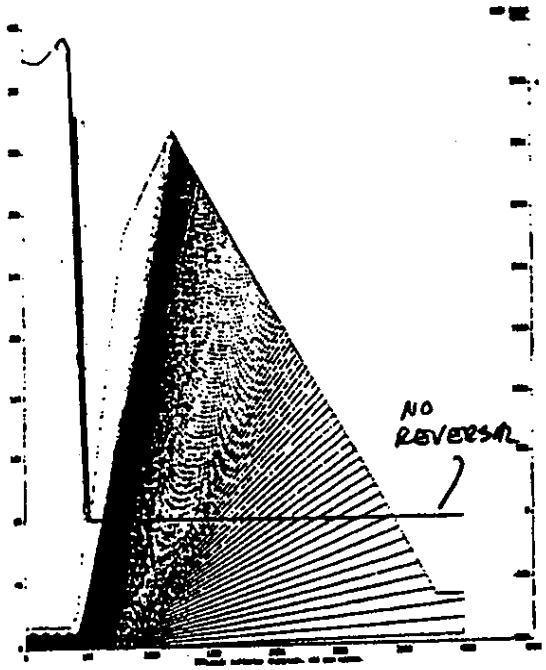

Figure 6: Simulation of electrons entering the collector region in the absence of a magnetic field reversal by use of a Gun-Only magnet.

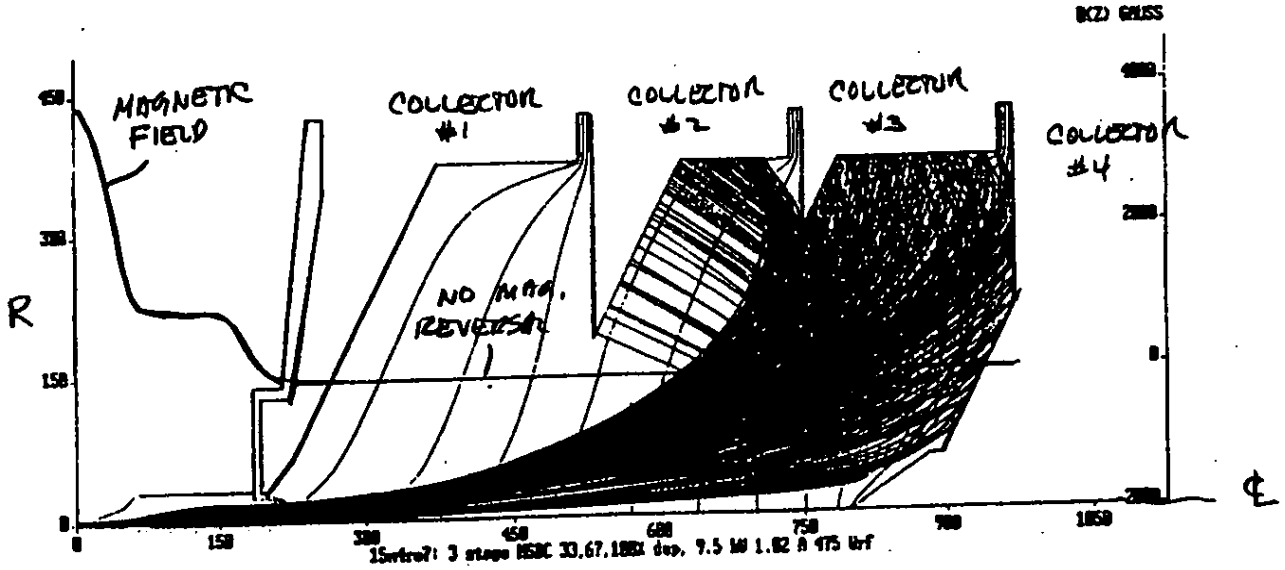

Figure 7: Simulation of electrons entering a three (3) stage MSDC collector.

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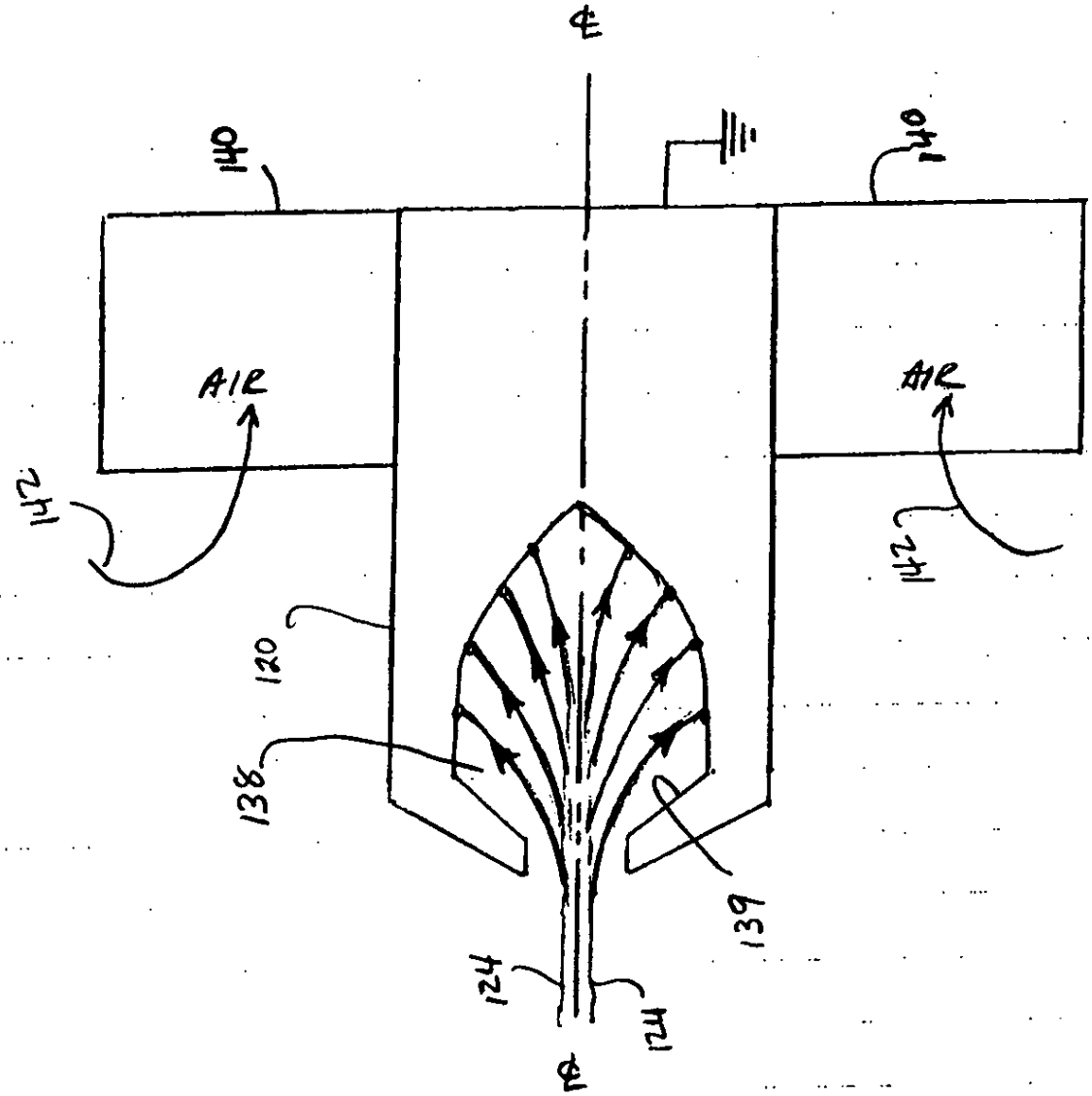

FIG. 8

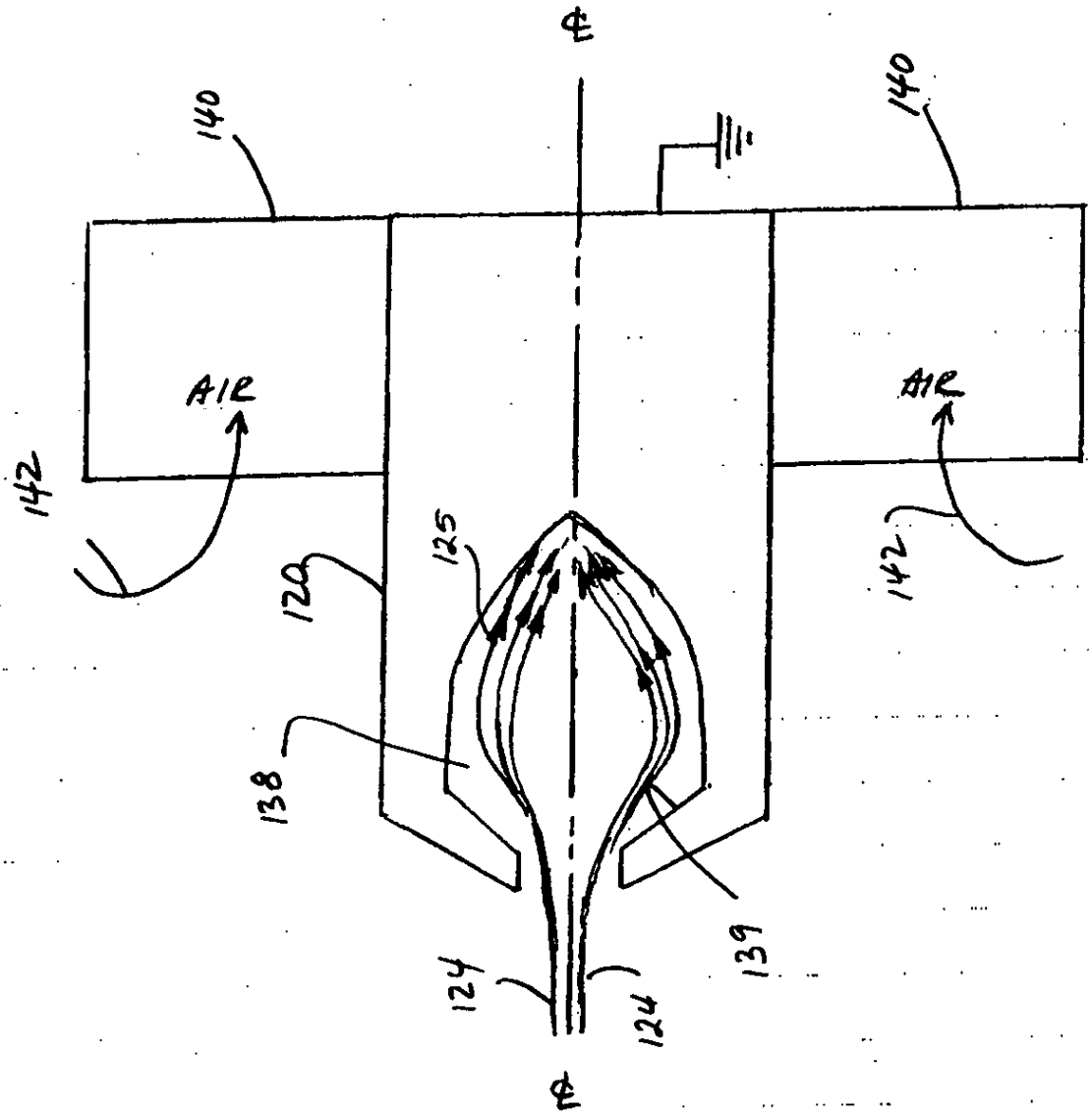

FIG. 9

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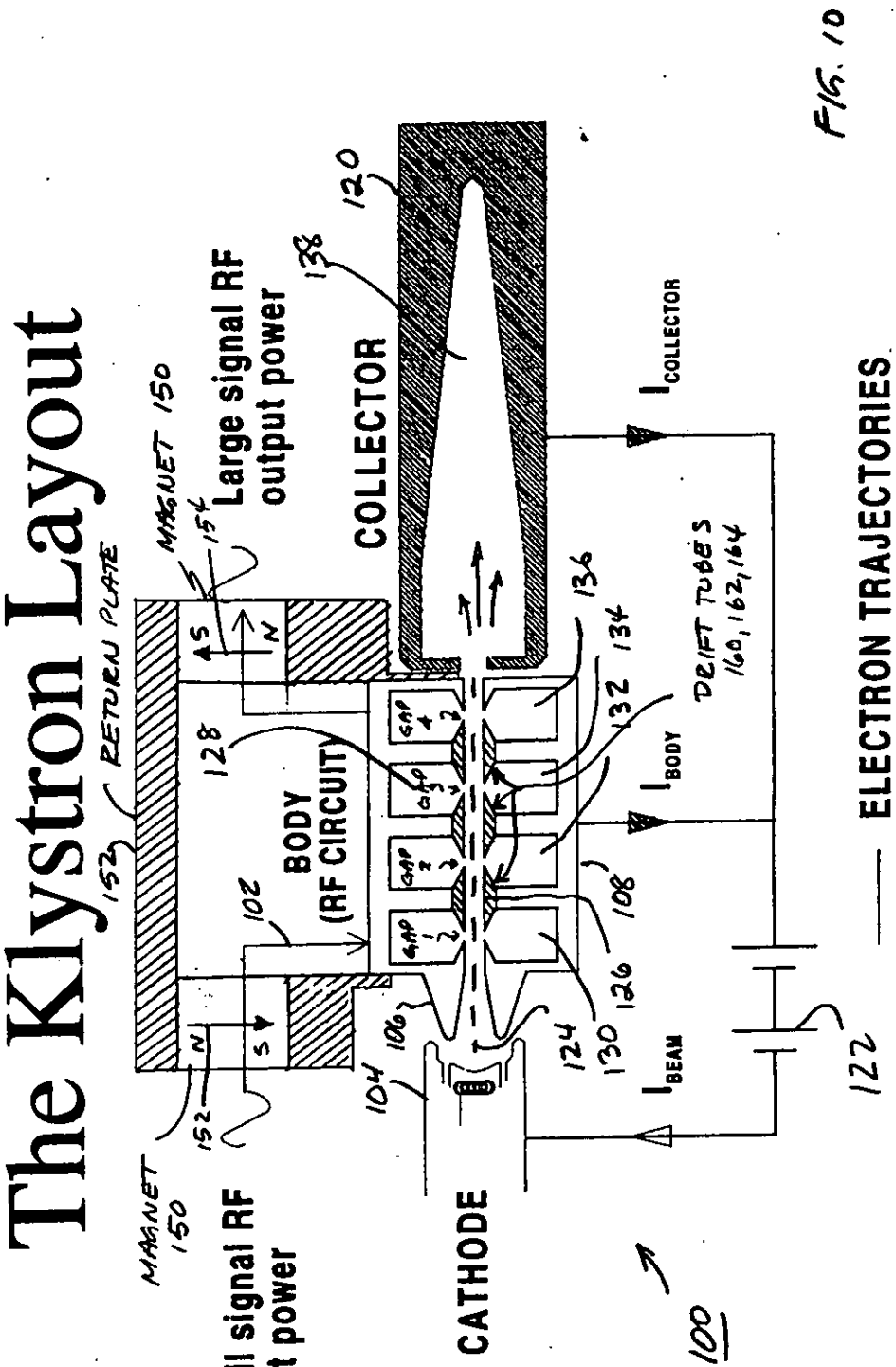

FIG. 10

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